5-Penny Battery

Kit contains:

- 5 pennies (post-1982, so they have zinc cores covered in copper)
- 1 red LED light
- 1 packet of malt vinegar
- 4 squares of matboard
- 1 mini rubber band
- 1 piece of sandpaper

You will need: a cup, spoon, water, salt, and dish towel or paper towels.

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INSTRUCTIONS

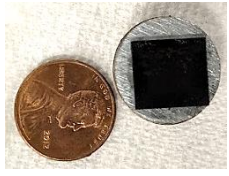
Step 1. Sand the copper completely off the "tails" side of 4 pennies to reveal the zinc cores. (The tails side is flatter, so this takes less work.) The easiest way to do this is to place the sandpaper on a flat surface and skate the penny back and forth with your fingertip. Leave the fifth penny intact.

Phew! Sanding is a lot of effort. You can take breaks or sand pennies in multiple sittings.

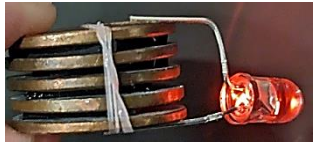
Step 2. Prepare an **electrolyte solution** to conduct electric current. Put 2 tablespoons of warm water in a cup. Stir in salt—as much as you can until it doesn't dissolve anymore. Then mix in your packet of vinegar.

Step 3. Soak the squares of matboard in your electrolyte solution. Then drain the on a towel until no longer dripping.

Step 4. Make an electricity sandwich (A.K.A., a **voltaic pile**). Place one sanded penny zinc side up. Put a piece of wet matboard on top. Add the next penny, zinc side up, followed by another piece of wet matboard. Repeat until you are out of matboard. Then, put the all-copper penny on top to close the sandwich. Wrap the mini rubber band around the stack to keep it from falling apart.



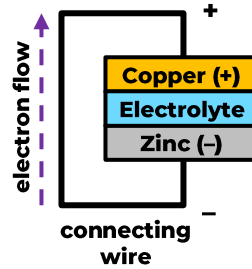
Step 5. Bend the wire leads on your LED light so that the shorter lead touches the bottom of the penny sandwich and the longer lead touches the top of the sandwich. The red light will power on.



Note: This project works with white vinegar, too.

WHAT'S GOING ON?

Batteries are devices that turn chemical energy into electric energy. Let's think about a single voltaic cell: in this case, a zinc-electrolyte-copper sandwich. When wires connect the two metals, it starts a chemical reaction. The zinc gives up electrons that flow through the wires and are taken by the copper. This single sandwich produces about 0.6 volt of electricity.



Is that enough power to turn on a light? Nope! A red LED light needs ~1.7 volts. Your 5-penny battery sandwich has 4 electrolyte "filling" layers and generates 0.6 V x 4 = 2.4 volts of electricity: definitely enough power! Different types of lightbulbs need more electricity to work. A blue LED requires 3.6 volts of electricity. How big of a penny sandwich would it need?

https://www.exploratorium.edu/snacks/penny-battery
https://www.britannica.com/science/electrolyte